

### Claims

What is claimed is:

1. A method for providing backpressure information from a physical layer device to a link layer device in a communication system, the method comprising the steps of:

5           generating a flow control message in the physical layer device responsive to a detected condition relating to at least a given one of a plurality of queues of the physical layer device; and

                  transmitting the flow control message from the physical layer device to the link layer device;

10           wherein the flow control message comprises backpressure information associated with the given queue of the physical layer device and is transmitted from the physical layer device to the link layer device as an in-band message over an interface between the physical layer device and the link layer device.

15           2. The method of claim 1 wherein the given queue has an upper threshold and a lower threshold associated therewith, corresponding to respective fullness levels of the queue.

20           3. The method of claim 2 wherein the flow control message comprises backpressure information indicating that the queue fullness has crossed the upper threshold from below that threshold.

                  4. The method of claim 2 wherein the flow control message comprises backpressure information indicating that the queue fullness has crossed the lower threshold from above that threshold.

25           5. The method of claim 1 wherein the flow control message comprises in addition to the backpressure information an identifier of the given queue with which the backpressure information is associated.

6. The method of claim 5 wherein the identifier comprises a logical MPHY value corresponding to the given queue.

7. The method of claim 1 wherein the flow control message identifies a particular one of a plurality of detected conditions relating to the given queue, the plurality of detected conditions comprising at least an over-threshold condition and an under-threshold condition.

8. The method of claim 7 wherein the plurality of detected conditions further comprises an empty queue condition and a full queue condition.

9. The method of claim 1 wherein the interface between the physical layer device and the link layer device comprises an SPI-3 ingress interface.

10. The method of claim 9 wherein the flow control message is transmitted at a highest priority level on the SPI-3 ingress interface between the physical layer device and the link layer device.

11. The method of claim 1 wherein the flow control message is deliverable from the physical layer device to a designated queue of the link layer device.

12. The method of claim 11 wherein the designated queue comprises a class of service (CoS) queue of the link layer device.

13. The method of claim 12 wherein the CoS queue is one of a plurality of CoS queues serviced by a quality of service (QoS) queue of the link layer device.

14. The method of claim 1 wherein the link layer device is operative to perform multiple-rate traffic shaping responsive to the backpressure information in the flow control message.

15. The method of claim 14 wherein the link layer device is operative to perform the multiple-rate traffic shaping by selecting one of a plurality of available scheduling rates for a channel associated with the egress queue of the physical layer device responsive to backpressure information in the flow control message.

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16. The method of claim 15 wherein the link layer device is operative to perform the multiple-rate traffic shaping by selecting a first one of the plurality of available scheduling rates for the channel if the backpressure information indicates an under-threshold condition, and selecting a second one of the plurality of available scheduling rates for the channel if the backpressure information indicates an over-threshold condition.

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17. The method of claim 16 wherein the first and second rates correspond to 100% and 80%, respectively, of a nominal High-level Data Link Control (HDLC) channel rate.

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18. An apparatus for use in generating backpressure information for transmission to a link layer device in a communication system, the apparatus comprising:

a physical layer device connectable to the link layer device and operative to generate a flow control message responsive to a detected condition relating to at least a given one of a plurality of queues of the physical layer device, the flow control message being transmittable from the physical layer device to the link layer device;

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wherein the flow control message comprises backpressure information associated with the given queue of the physical layer device and is transmitted from the physical layer device to the link layer device as an in-band message over an interface between the physical layer device and the link layer device.

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19. An apparatus for use in processing backpressure information received from a physical layer device in a communication system, the apparatus comprising:

a link layer device connectable to the physical layer device and operative to receive from the physical layer device a flow control message responsive to a detected condition relating to at least a given one of a plurality of queues of the physical layer device;

5 wherein the flow control message comprises backpressure information associated with the given queue of the physical layer device and is transmitted from the physical layer device to the link layer device as an in-band message over an interface between the physical layer device and the link layer device.

20. A method for providing multiple-rate traffic shaping in a link layer device in a  
10 communication system, the method comprising the steps of:

receiving from a physical layer device of the system a flow control message responsive to a detected condition relating to at least a given one of a plurality of queues of the physical layer device; and

15 selecting one of a plurality of available traffic shaping characteristics for utilization with a given channel between the link layer device and the physical layer device based at least in part on the flow control message.